

# HIGHER TECHNICAL INSTITUTE

ELECTRICAL ENGINEERING DEPARTMENT

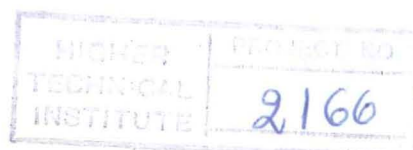
## DIPLOMA PROJECT

Microprocessor / Ultrasound Controlled  
Stepper Motor

**E-878**

**DOROS A. POULLIS**

**June - 1993**



## ACKNOWLEDGMENTS

I would like to express my sincere thanks to Mr. S. Hadjioannou who supervised and also gaved his quidance during the design and construction of this Diploma Project.

Thanks and appreciation is also expressed to some friends who helped solving problems during the design.

Finally, i would like to thank my family for advices and suggestions and especially my brother Joseph who granted me his fast computer and HP Laser Jet printer to finish this work.

## SUMMARY

### Microprocessor / Ultrasonic Stepper Motor Control

This project is based on the control of a stepper motor using the 8031 microprocessor and an ultrasonic transmitter/receiver. Also an interface card is used for the drive of a stepper motor.

#### Chapter 1:

##### 8031 Micocontroller :

Architecture of the microprocessor including hardware, input-output ports, external memory, serial data input-output, interrupts etc.

#### Chapter 2:

Ultrasonic Transmitter / Receiver.

#### Chapter 3:

Stepper Motors: The stepper motor choice, operation interfacing and control.

#### Chapter 4:

Block diagrams.

#### Chapter 5:

Circuit diagrams and design including control circuit, transmitter /receiver and motor interface card.

## Chapter 6:

Control program: Software design and explanation, including the 8031 operational code mnemonics, use of assembly language, flowchart.

## Chapter 7:

Testing: Explanation of the method used to design and construct this project including problems arising during construction and how they are overcome.

# CONTENTS

## INTRODUCTION

## CHAPTER 1

<b>1.1</b>	<b>Generally on Microcontroller Architecture .</b>	<b>1</b>
1.1.1	The Oscillator and clock of the 8031 uP.	4
1.1.2	Program Counter and Data Pointer registers.	5
1.1.3	CPU Registers.	5
1.1.4	Flags and PSW.	6
1.1.5	Internal RAM.	8
1.1.6	The Stack and Stack operation.	9
1.1.7	Special Function Registers (SFR).	10
<b>1.2</b>	<b>Input / Output Ports (Pins and circuits) .</b>	<b>11</b>
1.2.1	Port 0	13
1.2.2	Port 1	13
1.2.3	Port 2	13
1.2.4	Port 3	14
<b>1.3</b>	<b>External Memory.</b>	<b>14</b>
1.3.1	Important External Memory Pins.	15
1.3.2	Counters and Timers.	17
1.3.3	Timer Counter Interrupts.	19
1.3.4	Timer Modes of operation.	20
<b>1.4</b>	<b>Serial Data Input / Output.</b>	<b>21</b>
1.4.1	Data Transmission.	23
1.4.2	Data Reception.	23
<b>1.5</b>	<b>Interrupts.</b>	<b>24</b>

## CHAPTER 2

2.1	Operation of Ultrasonic Transmitter.	27
2.1.1	Timing formula.	30
2.1.2	Timing capacitor.	31
2.2	Operation of Ultrasonic Receiver.	31
2.2.1	Receiver	

## CHAPTER 3

3.1	The Stepper Motor.	33
3.2	The Stepper Motor Interface.	35
3.2.1	Operation of the Stepper Motor Interface.	37
3.3	Advantages and Disadvantages of Steppers Motors.	37

## CHAPTER 4

4.1	Block Diagram of the System.	39
-----	------------------------------	----

## CHAPTER 5

5.1	Circuit diagram of the control circuit and the motor interface.	40
5.2	Circuit diagram of the Ultrasonic Receiver.	41
5.3	Circuit diagram of the Ultrasonic Transmitter.	41
5.4	Circuit diagram of the Power Supply.	42

## CHAPTER 6

6.1 Stepper Motor control program. 43

6.1.1 Software program.

Flowchart 44

## CHAPTER 7

7.1 Testing 51

## CONCLUSIONS

## REFERENCES

## APPENDICES

### Appendix 1

- a) The 8051 Instruction Set.
- b) The 8051 Operational Code Mnemonics.
- c) 16K ERASABLE PROM.
- d) Octal D-type transparent latches with 3-State outputs.

### Appendix 2

- a) The 555-Timer.
- b) The Ultrasonic Transmitter / Receiver.

### Appendix 3

- a) 4-Phase Unipolar Stepper Motors.

### Appendix 4

- a) Printed Circuit Boards.